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Date: June 26, 2007 /Jessica Sexton/
Jessica Sexton

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of:

Applicant(s):	Khoi A. Phan, *et al.*	Examiner:	Thao X. Le
Serial No:	10/790,298	Art Unit:	2814
Filing Date:	March 1, 2004		

Title: HEAT REGULATING DEVICE FOR AN INTEGRATED CIRCUIT

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF

Dear Sir:

Applicant submits this brief in connection with an appeal of the above-identified patent application. Payment is being submitted via credit card in connection with all fees due regarding this appeal brief. In the event any additional fees may be due and/or are not covered by the credit card, the Commissioner is authorized to charge such fees to Deposit Account No. 50-1063 [SPSNP812US].

I. Real Party in Interest (37 C.F.R. §41.37(c)(1)(i))

The real party in interest in the present appeal is Spansion LLC, the assignee of the present application.

II. Related Appeals and Interferences (37 C.F.R. §41.37(c)(1)(ii))

Appellants, appellants' legal representative, and/or the assignee of the present application are not aware of any appeals or interferences which may be related to, will directly affect, or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III. Status of Claims (37 C.F.R. §41.37(c)(1)(iii))

Claims 1-7, 23, 25-27, and 32-34 stand rejected by the Examiner. The rejection of claims 1-7, 23, 25-27, and 32-34 is being appealed.

IV. Status of Amendments (37 C.F.R. §41.37(c)(1)(iv))

Claims 28-31 were cancelled while claims 1 and 7 were amended for better form subsequent the Final Office Action dated January 30, 2007 (*See* Communication from Examiner dated April 19, 2007).

V. Summary of Claimed Subject Matter (37 C.F.R. §41.37(c)(1)(v))

A. <u>Independent Claim 1</u>

Independent claim 1 recites a heat regulating device for regulating a heat flow into and out of an integrated circuit semiconductor body. The device comprises: a plurality of thermo-electrical structures that create a uniform temperature gradient across an integrated circuit semiconductor body via at least one of heat inducement to or dissipation of generated heat away from a portion of the integrated circuit semiconductor body (*See e.g.*, page 3, lines 1-13). The device further comprises at least one layer of a conductive material in contact with the plurality of thermo-electrical structures for conducting heat flow (*See e.g.*, page 4, lines 9-14). Additionally, at least one of the plurality of the thermoelectric structures is shaped such that it has a distribution of line patterns that is denser towards center of its structure and decreases in density towards outer limits of the structure (*See e.g.*, page 3, lines 29-32).

B. <u>Independent Claim 7</u>

Independent claim 7 recites a heat regulating device for regulating a heat flow of an integrated circuit comprising: at least one of means for inducing heat into a portion of a semiconductor body of the integrated circuit utilizing a plurality of thermo-electric structures or means for dissipating heat away from a portion of a semiconductor body of the integrated circuit utilizing a plurality of thermo-electric structures (*See e.g.*, page 3, lines 1-13). At least one of the heat inducing means or heat dissipating means create a uniform temperature gradient across the semiconductor body (*See e.g.*, page 2, lines 30-34). The heat regulating device further comprises heat conducting means in contact with the means for inducing heat into or dissipating heat away from the portion of the semiconductor body (*See e.g.*, page 4, lines 9-14). At least one of the plurality of the thermoelectric structures has a structure with a distribution of line patterns that is denser towards center of the structure and progressively less dense towards outer edges of the structure (*See e.g.*, page 3, lines 29-32).

C. <u>Independent Claim 34</u>

Independent claim 34 recites a system for reducing the accumulation and concentration of stress in an integrated circuit, comprising means for creating a uniform temperature gradient throughout the integrated circuit based at least in part upon one of a heat dissipation and a heat induction (*See e.g.*, page 3, lines 5-13). The means for creating a uniform temperature gradient has a denser distribution of line patterns towards center of its structure and a less dense distribution of lines towards outer limits of the structure (*See e.g.*, page 3, lines 29-32).

VI. Grounds of Rejection to be Reviewed (37 C.F.R. §41.37(c)(1)(vi))

A. Whether claims 1-7, 23, 25-26 and 32-34 are unpatentable under 35 U.S.C. §103(a) over Levinson, *et al.* (U.S. 6,098,408) in view of Cannell, *et al.* (U.S. 6,729,383).

B. Whether claim 27 is unpatentable under 35 U.S.C. §103(a) over Levinson, *et al.* (U.S. 6,098,408) in view of Cannell, *et al.* (U.S. 6,729,383) as applied to claim 1 above and further in view of Ghoshal (U.S. 6,105,381).

VII. Argument (37 C.F.R. §41.37(c)(1)(vii))

A. Rejection of Claims 1-7, 23, 25-26 and 32-34 Under 35 U.S.C. §103(a)

Claims 1-7, 23, 25-26 and 32-34 stand rejected as obvious under 35 U.S.C. §103(a) over Levinson, *et al.* (U.S. 6,098,408) in view of Cannell, *et al.* (U.S. 6,729,383). Reversal of this rejection is requested for at least the following reasons. The cited references, either alone or in combination, fail to teach or suggest all limitations of the subject claims.

> To reject claims in an application under §103, an examiner must establish a *prima facie* case of obviousness. A *prima facie* case of obviousness is established by a showing of three basic criteria. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second there must be a reasonable expectation of success. Finally, ***the prior art reference (or references when combined) must teach or suggest all the claim limitations.*** *See* MPEP §706.02(j). The teaching or suggestion to make the claimed combination and the reasonable expectation of success must be found in the prior art and not based on the Applicant's disclosure. *See In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

The subject claims relate to a system for regulating and monitoring heat dissipation of a semiconductor device. A plurality of thermoelectric structures is employed to maintain a uniform temperature gradient throughout the semiconductor body. To this end independent claims 1, 7 and 34 recite similar features namely: ***at least one of the plurality of the thermoelectric structures has a distribution of line patterns that is denser towards center of its structure and decreases in density towards outer limits of the structure.*** Neither Levinson, *et al.* nor Cannell, *et al.* teach or suggest such novel aspects.

Levinson, *et al.* relates to a system for regulating reticle temperature. It teaches employing a plurality of thermoelectric coolers mounted on a backplate of a chuck assembly. The cold side of the thermoelectric coolers is operatively couple with the backplate, and the backplate thermally conducts heat between the reticle and the thermoelectric coolers (*See* Levinson, *et al.* col.2 lines 25-36). However, as conceded on page 3 of the Final Office Action

dated January 30, 2007, Levinson, *et al.* does not teach or suggest a thermoelectric structure with a pattern of lines that is dense at the center and is progressively less dense towards the outer edges of the structure as recited in applicants' independent claims. The Examiner offers Cannell, *et al.* to overcome this deficiency. However, Cannell, *et al.* also fails to teach or suggest such novel aspects.

Cannell, *et al.* relates to methods and apparatus to cool electronic components and other objects, involving removal, absorption and/or dissipation of heat (*See* Cannell, *et al.* col.1 lines 11-16). Accordingly, a pin array is disposed between a surface region of a heat sink and the surface of an entity to be cooled. Cooling fluid flows between the heat sink's surface and the entity's surface region through the space occupied by the pins. The fluid is further agitated by the pins. At the cited portion, Cannell, *et al.* discusses conventional heat sinks which feature various arrangements and configurations of protrusive structuring. These structures are were intended to increase the heat sink's size parameters, thereby increasing the amount of heat transfer surface. Hence, according to Cannell, *et al.* it is the protrusive structuring that increases the overall heat transfer coefficient of the heat sink (*See* Cannell, *et al.* col.2 lines 43-45 and 49-55). In fact, none of the various shapes of pins disclosed in different figures of Cannell, *et al.* teach or suggest a pattern with a denser distribution of line structures towards the center and a less dense distribution of lines towards the edges of the structure (*See* Cannell, *et al.* col.10 lines 25-32 and Figures 26-29). Additionally, Cannell, *et al.* nowhere teaches or suggests use of thermoelectric structures for heat dissipation let alone teach or suggest thermo-electric structures with the claimed patterns.

The claimed subject matter generally relates to addressing localized heating problems within a semiconductor chip. As a result of non-uniform distribution of heat across a semiconductor body comprising both low and high power circuits, "hot-spots" are created. These cause excessive, concentrated and non-uniform chip stresses leading eventually to chip failure (*See* applicants' specification as filed page 2 lines 1-8). The subject claims provide for removing generated heat from hot spot areas and/or inducing heat at other areas of the semiconductor chip to create a uniform temperature gradient across a semiconductor body. The claimed thermoelectric structures prevent excessive and concentrated chip stresses that result from a non-uniform temperature gradient *via* a pattern having a distribution of lines that are denser at the center and less dense towards the edges of the structure. Accordingly, when the

thermoelectric structures are coupled with the hot-spots, the denser distribution of line patterns aid in removing and/or inducing heat faster as compared with the less dense line patterns in their respective areas of the semiconductor device. This pattern of the thermoelectric structures echoes the pattern of heat generation within the semiconductor body wherein the intensity of heat near high power circuits is higher as compared with other areas of the semiconductor body. For example, applicants' Figure 1 clearly illustrates this non-uniformity of the temperature gradient within the semiconductor body (*See* also applicants' specification as filed page 7 lines 10-14, Fig.2a and page 8 lines 1-3). Thus, thermoelectric structures with the claimed line patterns advantageously provide better uniformity in temperature gradient across a semiconductor body as compared with thermoelectric structures without such patterns.

From at least the foregoing, it is clear the cited documents alone or in combination fail to teach or suggest all aspects recited in independent claims 1, 7 and 34. Therefore, it is requested that this rejection be reversed with respect to independent claims 1, 7, 34 and all the claims that depend there from.

B. <u>Rejection of Claim 27 Under 35 U.S.C. §103(a)</u>

Claim 27 stands rejected as obvious under 35 U.S.C. §103(a) over Levinson, *et al.* (U.S. 6,098,408) in view of Cannell, *et al.* (U.S. 6,729,383) as applied to claim 1 above and further in view of Ghoshal (U.S. 6,105,381). Reversal of this rejection is requested for at least the following reasons. Claim 27 depends on independent claim 1. The cited references, either alone or in combination, fail to teach or suggest all features of independent claim 1.

As stated *supra*, the subject invention is directed towards mitigating the formation of hotspots in a semiconductor body of an integrated circuit by creating a uniform temperature gradient. To this end, it employs a plurality of thermoelectric structures wherein at least one thermoelectric structure has a denser distribution of line patterns towards the center and less dense towards the outer limits of the structure. As stated on page 3 of the Final Office Action dated January 30, 2007, Levinson, *et al.* does not teach or suggest such claimed aspects. Ghoshal fails to make up for this deficiency of Levinson, *et al.* with respect to independent claim 1. Ghoshal relates to an apparatus for cooling GMR (Giant Magnetoresistive Sensors) in hard disk drives to enhance magnetic sensing capacity of GMR elements. A thermoelectric cooling (TEC) cooling device is thermally coupled in close proximity to a GMR head chip or data

storage device component. Heat is extracted from GMR head chip by heat transfer to the cold end of the TEC device or alternately to a thermal spreader pad on the hot end of an integrated GMR/TEC device (*See* Ghoshal col.2 lines 30-40). However, Ghoshal fails to teach or suggest a TEC device with line patterns as disclosed in independent claim 1 from which claim 27 depends.

From the foregoing, it is clear that the cited documents either alone or in combination do not teach or suggest all aspects of the subject claim. Therefore, this rejection with respect to claim 27 should be reversed.

C. <u>Conclusion</u>

For at least the above reasons, the claims currently under consideration are believed to be patentable over the cited references. Accordingly, it is respectfully requested that the rejections of claims 1-7, 23, 25-27, and 32-34 be reversed.

If any additional fees are due in connection with this document, the Commissioner is authorized to charge those fees to Deposit Account No. 50-1063 [SPSNP812US].

Respectfully submitted,
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VIII. Claims Appendix (37 C.F.R. §41.37(c)(1)(viii))

1. A heat regulating device for regulating a heat flow into and out of an integrated circuit semiconductor body comprising:

a plurality of thermo-electrical structures that create a uniform temperature gradient across an integrated circuit semiconductor body via at least one of heat inducement to or dissipation of generated heat away from a portion of the integrated circuit semiconductor body;

at least one layer of a conductive material in contact with the plurality of thermo-electrical structures for conducting heat flow; and

at least one of the plurality of the thermoelectric structures has a distribution of line patterns that is denser towards center of its structure and decreases in density towards outer limits of the structure.

2. A heat regulating device according to claim 1, each of the thermo-electrical structures is a trough within the body of the layer of the conductive material.

3. A heat regulating device according to claim 1, the plurality of the thermo-electrical structures form a spreading assembly.

4. A heat regulating device according to claim 3, the spreading assembly is operatively connected to a heat sink.

5. A heat regulating device according to claim 1, each of the thermo-electrical structures is a conductive pathway for heat transfer.

6. A heat regulating device according to claim 1, each of the thermo-electrical structures has a structure of line patterns selected from a group comprising: maze-shaped structure, helix structure, and a spring structure.

7. A heat regulating device for regulating a heat flow of an integrated circuit comprising:

at least one of means for inducing heat into a portion of a semiconductor body of the integrated circuit utilizing a plurality of thermo-electric structures or means for dissipating heat away from a portion of a semiconductor body of the integrated circuit utilizing a plurality of thermo-electric structures;

at least one of the heat inducing means or heat dissipating means create a uniform temperature gradient across the semiconductor body;

heat conducting means in contact with the means for inducing heat into or dissipating heat away from the portion of the semiconductor body; and

at least one of the plurality of the thermoelectric structures has a structure with a distribution of line patterns that is denser towards center of the structure and progressively less dense towards outer edges of the structure.

8-22. (Cancelled)

23. A heat regulating device according to claim 3, with components embedded into the spreading assembly to manage the heat flow away from and/or into the integrated circuit semiconductor body.

24. (Canceled)

25. A heat regulating device according to claim 1, each of the thermo-electrical structures being embedded with measuring devices to measure various physical properties of the integrated circuit semiconductor body.

26. A heat regulating device according to claim 1, each of the thermo-electrical structures being an external element attached to the surface of the heat regulating device.

27. A heat regulating device according to claim 1, fabricated from a combination of various layers of silicon carbide and diamond.

28. - 31. (Cancelled)

32. A heat regulating device according to claim 1, each of the thermo-electrical structures is a composite composed of a layer having at least one part tailored to a heat-generating characteristic of a portion of the integrated circuit semiconductor body.

33. A heat regulating device according to claim 1, at least one thermo-electric structure is integrated with the semiconductor body such that the thermo-electrical structure is positioned in a region of the semiconductor body where a hot spot is anticipated.

34. A system that facilitates reducing the accumulation and concentration of stress in an integrated circuit, comprising:

means for creating a uniform temperature gradient throughout the integrated circuit based at least in part upon one of a heat dissipation and a heat induction; and

the means for creating a uniform temperature gradient has a denser distribution of line patterns towards center of its structure and a less dense distribution of lines towards outer limits of the structure.

IX. Evidence Appendix (37 C.F.R. §41.37(c)(1)(ix))

None.

X. Related Proceedings Appendix (37 C.F.R. §41.37(c)(1)(x))

None.